Inhalation versus balanced anesthesia in pediatric patients

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The authors review their experiences with randomly selected patients who underwent inguinal herniorrhaphy at a pediatric hospital. They compare the postoperative complications encountered following two different techniques: inhalation and balanced anesthesia.

Because of the ever-expanding nature of their field, health care professionals must periodically assess the results of their efforts; it is in this manner that techniques are refined, progress is made, and patients are provided with better care. This obligation was the stimulus for the study reported in this article.

Materials and methods

This retrospective study compared the results of anesthesia in patients who underwent inguinal herniorrhaphy using two different methods: inhalation anesthesia and balanced anesthesia.

For the purposes of this study, inhalation anesthesia refers to an anesthetic technique in which the primary anesthetic is introduced to the bloodstream via the lungs rather than by injection. Patients who received adjunctive muscle relaxants were not included in the study. While patients receiving any potent inhalation agent as the primary anesthetic would have qualified, note that the only agent patients received was halothane in conjunction with oxygen and nitrous oxide.

Balanced anesthesia refers to an anesthetic technique in which the primary anesthetic agent is injected and used in conjunction with a muscle relaxant and an inhaled oxygen-nitrous oxide mixture. In this study, the injected primary agent was always a narcotic. If potent inhalation agents were used for induction, they were discontinued as soon as an intravenous route was established.

Two groups of patients were selected and the results of their anesthetic experiences compared. The first group consisted of 22 patients who received an inhalation anesthetic. Group II consisted of eight patients who received a balanced anesthetic. The subjects were chosen randomly from patients who had undergone anesthesia for inguinal herniorrhaphy at the Children's Hospital of Birmingham, Alabama during a period extending from January, 1979 to May, 1980.

In order to have two comparable groups in which the major differing factor was the type of anesthetic used, the following criteria were set for entrance into the study (Table I). Patients who did not meet all of the criteria were not included.

1. Patients underwent repair of inguinal hernia only, without any associated procedure such as umbilical hernia repair or circumcision.
2. Patient age was between 12 months and 5 years at the time of operation.
3. Patients received no preoperative medication other than atropine or glycopyrrolate.
4. Patients were all ASA classification I or II.

Results

Methods of airway management and the incidence of post-operative sore throat were compared (Table II). Some events which characterize the patients' post-operative courses are summarized in Table III.

Nausea and/or vomiting was recorded in the
recovery room record or in the nurses' notes as having occurred within 8 hours of the end of anesthesia. Table III indicates the number of patients who experienced nausea or vomiting, not the number of incidents per individual.

For the purposes of this study, fever is defined as an oral temperature greater than 100°F or a rectal temperature greater than 101°F occurring within 24 hours of the end of the anesthetic. Postoperative pain was recorded for those patients with pain severe enough to require treatment with analgesics. Table III indicates the number of patients who required analgesics during a four-hour period after the end of anesthesia, rather than the number of analgesics received.

Disorientation, behavior labeled or described as such in the nurses' notes or recovery room records, did not occur. The patients were observed for this behavior beginning with their entry into the recovery room until eight hours after charted anesthetic ending time.

Time to oral intake is the time in hours and minutes from the end of anesthesia to the first oral intake as charted in the nurses' notes or recovery room record (Table III).

Some patients in each group were scheduled as admissions to the “One Day Admission Unit” but were required to stay overnight. In the inhalation anesthesia group one patient was admitted due to postoperative nausea and vomiting. Another was admitted because of a failure to take oral fluids for several hours postoperatively.

In the balanced anesthesia group, one patient was admitted because he had a postoperative fever, and two were admitted for evaluation of croup-like symptoms (which had their onset postoperatively). The number of patients admitted overnight from the “One Day Unit” in the two groups—two in the inhalation group and three in the

### Table I

**Patient characteristics**

<table>
<thead>
<tr>
<th></th>
<th>Inhalation anesthesia</th>
<th>Balanced anesthesia</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>22</td>
<td>8</td>
<td>——</td>
</tr>
<tr>
<td>Patient ages (in months)</td>
<td>24.3±3.1*</td>
<td>24.4±5.3*</td>
<td>p &gt; 0.9**</td>
</tr>
<tr>
<td>Anesthetic time (in minutes)</td>
<td>80±5*</td>
<td>75±6*</td>
<td>p &gt; 0.9***</td>
</tr>
</tbody>
</table>

*mean ± S.E.M.
**Student's t test: t=0.003
***Student's t test: t=0.06

### Table II

**Incidence of postoperative sore throat (in the ratio of number of patients with a given method of airway management to the number in that group with postoperative sore throat)**

<table>
<thead>
<tr>
<th></th>
<th>Inhalation anesthesia</th>
<th>Balanced anesthesia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endotracheal tube only</td>
<td>18/1</td>
<td>7/0</td>
</tr>
<tr>
<td>Oral airway only</td>
<td>2/0</td>
<td>0/0</td>
</tr>
<tr>
<td>Both</td>
<td>1/1</td>
<td>1/1</td>
</tr>
<tr>
<td>Neither</td>
<td>1/0</td>
<td>0/0</td>
</tr>
</tbody>
</table>

### Table III

**Postoperative complications**

<table>
<thead>
<tr>
<th></th>
<th>Inhalation anesthesia</th>
<th>Balanced anesthesia</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nausea &amp; vomiting</td>
<td>5</td>
<td>0</td>
<td>p &gt; 0.36*</td>
</tr>
<tr>
<td>Fever</td>
<td>4</td>
<td>1</td>
<td>p &gt; 0.8*</td>
</tr>
<tr>
<td>Disorientation</td>
<td>0</td>
<td>0</td>
<td>——</td>
</tr>
<tr>
<td>Time to oral intake</td>
<td>1 hr 57 min ±29 min</td>
<td>2 hr 48 min ±65 min</td>
<td>p &gt; 0.9**</td>
</tr>
</tbody>
</table>

*2x2 contingency table studied by means of Fisher’s exact test
**Student's t test: t=0.013
balanced group does not differ significantly. (Fisher’s exact test, p > 0.18).

Discussion
The effects of different types of anesthesia on various phenomena at the cellular and organic levels have been greatly studied in recent years. It is equally important to know how various anesthetic agents influence parameters by which health care personnel and the patients themselves judge their well-being and fitness for discharge from anesthesia care. Comparisons in this area are meager—particularly in the pediatric age group.

In his classic textbook on pediatric anesthesia, Smith lists two studies which compare the irritating qualities of enflurane and halothane which influence the ease of induction. He also mentions a study in which the incidence of recovery vomiting after halothane, enflurane, and isoflurane are compared. Although these comparisons within the inhalation group of anesthetics are informative and pertinent, no comparison is made between inhalation agents and “balanced” techniques.

Casey Blitt, in discussing outpatient anesthesia, makes comparisons between nitrous-narcotic relaxant anesthesia and volatile anesthesia in the adult patient. Blitt’s study is an excellent comparison of such factors as cost, toxicity, cardiovascular and respiratory effects, skill and technique limitations, and the like via a literature review and the author’s personal experience. For most anesthesia personnel in most settings, Blitt believes that inhaled anesthesia is superior to nitrous-narcotic-relaxant for adult outpatient procedures. It must be noted that, in Blitt’s opinion, outpatients who receive anesthesia “go home” equally rapidly after inhaled or injected agents provided that the agents are administered properly. Unfortunately, Blitt’s article does not deal with the pediatric patient at all.

Dechene compares recovery performance between two inhalation agents in children; he also compares performance following two different drug regimens for balanced anesthesia in adults. In neither age group, however, are the aftereffects of any inhalation agent compared to those of any balanced agents.

One may ask, “Why are these comparisons not being made?” One possibility is that, as clinical anesthetists, we feel that we already know the answers, and that there is no need for formal study in the area. For example, in the institution where this study was performed, some held the belief that pain was more pronounced after inhalation techniques, and nausea was more prominent after a technique which involved the use of a narcotic. Our results supported neither of these beliefs.

Another possibility is that anesthesia personnel believe that balanced anesthesia is inappropriate for the pediatric population. In an institution such as the Children’s Hospital of Birmingham where many anesthetics are given annually, balanced anesthesia in skilled hands has been shown to have many useful applications. This study showed that there were no inherent differences in postoperative recovery related to the types of anesthesia administered.

In designing the study, an operative procedure was chosen which, in the pediatric population, does not have a high incidence of complications related to the operation itself. The two patient groups reviewed in this study are similar in every respect except in terms of basic anesthetic technique employed. It is reasonable, therefore, to compare the results and assume that any major differences in outcomes may be due to the technique employed rather than to inherent differences in the patient populations themselves.

In conclusion, a comparison (by review of chart documentation) of the incidence of sore throats, vomiting, disorientation, pain, fever, and length of time to oral intake revealed no significant differences in postoperative recovery between patients who received an inhalation anesthetic and those who received a balanced anesthetic.

REFERENCES

AUTHORS
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Shirley Boroughs Stanley, CRNA, BS, is a 1975 graduate of the University of Alabama School of Nursing, and a 1976 graduate of the Baptist Medical Centers School of Anesthesia in Birmingham, Alabama. She was employed as an anesthetist at the Children's Hospital of Birmingham, Alabama when she wrote this article. She has since relocated to Brooklyn Center, Minnesota.
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